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PERFORMANCE OF SOME EGYPTIAN CLOVER CULTIVARS AND THEIR TOLERANCE TO DODDER INFESTATION

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By
Maha F. El-Enany and E. M. Zayed*

*Weed Research Laboratory, and *Cell Study Research Department, Field Crops Research Institute, Agricultural Research Center Giza, Egypt.*

ABSTRACT

Dodder parasite (*Cuscuta planiflora*. L) is the main obstacle which causes drastic yield losses in Egyptian forage clover crop in Egypt, accompanied with seed contamination by dodder seeds due to their similarity in size and shape to clover seeds. The present study aimed to determine the magnitude of yield losses due to dodder infestation and to estimate the degree of tolerance of some important Egyptian clover cultivars to dodder infection. Five forage clover cultivars, namely Gemmeza 1, Giza 6, Sakha 4, Helaly and Serw were tested to determine the magnitude of yield losses in these cultivars to dodder infestation and their degree of dodder tolerance under five dodder artificial infestation rates, 0, 0.01, 0.02, 0.03 and 0.04 g/pot of dodder seeds carried out in two pot experiments during 2015/2016 and 2016/ 2017 winter seasons in complete randomized block design. Under dodder infestation rates at 0.01, 0.02, 0.03 and 0.04 g/pot the dry forage yield of clover losses were estimated by 32.6,37.9,47.8 and 54.4%, respectively, in 2016 season, and 31.8,46.6,54.6 and 63.7%,, respectively, in 2017 season as compared with the yield of clover free from dodder infestation. The effect of interaction between clover cultivars X dodder seeding infestation rate (g/pot) show that studied cultivars namely Gemmeza 1, Giza 6, Helaly, and Sakha 4 had the lowest infestation rates under 0.01-0.02g/pot of dodder seeds accompanied with increases in fresh and dry weight forage /pot, stem weight and stem length and high tolerance index (70-73%) with Sakha 4compared to El Serw 1 cultivar with the lowest tolerance index (26.1-32.9%), and can be classified as susceptible cultivar to dodder infestation. Such results suggest that breeders can select highest tolerant cultivars of clover under artificial infestation rates accompanied with decrease in dodder infestation %.

Keywords: *Egyptian clover, tolerance, dodder infestation.*

1. INTRODUCTION

Dodder (*Cuscuta planiflora* L.) is an obligate parasite on Egyptian clover. Dawson *et al.* (1994) mentioned that dodder is a completely rootle parasite free from chlorophyll and attacks the host plant for support and food supply. Khanh (2007) reported that *Cuscuta spp.* contains allelophathic potential exerting strong inhibition against the growth of the host plant that may be attributed to cinnamic acid and meththyl cinnamate, which are responsible for the phytotoxic action of dodder plants. Clover seeds, especially uncertified seeds are usually contaminated with huge amounts of dodder seeds as mentioned by (Lanini and Kogan, 2005; El-Refaey *et al.*, 2014, and Abdel–Hamid and El-Khangry (2006).

El-Nahrawy *et al.* (2014), mentioned that resistance/tolerance to dodder among the berseem genotypes should be evaluated for fresh and dry forage yield in all cuts and seasonal yield. They found that Giza 6 had reduction of 43.3% of clover yield under dodder infestation than its healthy plants due to the reduction in chlorophyll by 94% and concluded that the reduction in fresh and dry weights of clover compared healthy clover plants are in chlorophyll reduction. Zaki *et al.* (1998) and Abd–El Wahed (1996) found from a histological study that dodder can attach clover stem and reach the vascular cylinder.

Dodder control requires an integrated approach to be conducted over a period of many years (Lanini and Kogan, 2005). El-Refaey *et al.*, (2014) mentioned that uncertified clover seeds which are contaminated with dodder seeds which affecting negatively both productivity and quality of produced forage. In Egypt, dodder is a

serious problem in the fields of forage with available clover cultivars. AL-Menofy and Hassan (1977) found that yield of fresh material and dry matter of the infested plants of berseem with *Cuscuta planiflora* decreased by 20 and 34% and nutritive plant materials were reduced by 31% in the infested patches as compared with healthy plants. Earliest work about the mechanism of dodder tolerance to some crop plants were done by Al- Monufi and Ashton (1991) who studied the susceptibility and resistant of some *Lycopersicne* species to *Cuscuta campestris* infection. They found that the parasite failed to grow normally in *L. hurstum* that less susceptible to dodder infestation.

Narayana and Rao (1991) studied the tolerance of blackgram and green gram varieties to dodder (*Cuscuta chinensis* L.) and found among fifteen blackgram and sixteen gram screened for tolerance to *Cuscuta* resistance that two varieties of blackgram showed some tolerance. This resistance could be due to hypersensitive reaction of the host cells to *Cuscuta* infestation resulting in isolation of haustorial channels from the host vascular system. There are several causes of resistance of crop plants to cuscuta infestation viz hypersensitive reaction of host cells in *Lycopersicne* and *Phasolus spp.*. (Tsivion, 1979), formation of suberized layer of cells from secondary meristem in cotton (Capderon *et al.*, 1985).

2. MATERIALS AND METHODS

Two pot experiments were conducted in 2015/2016 and 2016/2017 winter seasons. Fifty cm pots diameter were filled with clay soil in wire house of the Weed Research Central Laboratory, Agricultural Research Center (ARC) Giza, to evaluate the effect of different infestation rates of dodder on forage yield and yield component of five Egyptian clover cultivars namely Gemmeza 1, Giza 6, Sakha 4, Helaly and El Serw1, which were obtained from the Forage Department, Field Crops Research Institute, ARC, Egypt. Each experiment consisted of 100 pots, were artificially infested with five rates of dodder seeds at 0.01, 0.02, 0.03 and 0.04 g dodder seeds/ pot which were collected from clover fields at Gemmeza Research Station in the previous season. Four replicates were sown in 1/10/1015 and 1/10/2016 by the five clover cultivars. Each pot was seeded by 0.5 gram of clover seed , the forage yield as g/pot was cut four times, every forty five days with irrigation twice each week by two liters per each pot, without fertilizers. The following data were recorded every cut.

1- Dodder infestation cover percentages per pot were determined by visual assessment.
2- Forage fresh weight, g/pot.
3- Forage dry weight, g/pot.
4- Stem length, cm.
5- Weight of stem, g/plant.
6- Number of leaves/plant.
7- Tolerance of clover cultivars to dodder infestation by estimating tolerant index. This measure was adapted according to the scale used by Hassanein *et al.* (1998) as shown in Table (A). Clover yield losses for each cultivar due to dodder infestation were estimated according to the following formula.

2.1. Statistical analysis:- Collected data were statistically analyzed using analysis of variance

$$\text{Tolerant yield index} = \frac{\text{yield of non- infested clover (g/pot) - yield of infested clover (g/pot)}}{\text{yield of non-infested clover (g/pot)}} \times 100$$

Table (A): Suggested scale of clover tolerant to dodder infestation adopted scale used to evaluate Orobanche resistant for faba bean cultivar according to Hassanein *et al.*, (1998).

Clover crop yield tolerant index due to dodder infestation	Degree of tolerance
100	**Immune**
100	**Resistant**
90-70	**Tolerant**
60	**Moderately tolerant**
50-30	**Susceptible**
20-0	**Very Susceptible**

of the split plot design according to procedure outlined by Steel and Torrie (1979), using MSTAT-C computer package (Freed *et al.* 1989). Treatments means were performed using least significant difference at 5% level probability.

3. RESULT &DISCUSSION

3.1. Effect of clover cultivars, dodder infestation seeding rate (g/pot) and interaction on dodder infestation coverage % to clover plants

Data in Table (1) and Fig. (1) show that the effect of clover cultivars, dodder seeding rates and their interactions on dodder infestation coverage % in the four clover cuts or their general average during 2015/2016 and 2016/2017 winter seasons were statistically significant at 5 the % level. Dodder infestation appeared in all clover cuts except with the 1st cut in the 1st season and the highest infestation rates appeared in the 3rd cuts and decreased in the 4th cut. This may be due to the variations in temperature in both seasons. Asaad *et al.* (1982) and El-Anany (2002) found that dodder seeds can germinate over a wide range of temperature, but the optimum temperature for seed germination as well as seedling growth is 18 ^{o}C average daily temperatures. Concerning the coverage % of dodder, it is obvious that Gemmeza 1 exert slight decrease in coverage% in the mean of cuts with (17.3%) than EL-Serw cultivar (20.5%) in the 1st season. Meanwhile, there was no significant trend among clover cultivars except significant reduction in the coverage % in the 3rd cut in both season, EL-Serw cultivar by (40.7%&64.7%). Increasing dodder infestation rate by dodder seeds from 0 to 0.04 g seeds /pot increased consistently and significantly dodder infestation coverage % on all cuts and their average were estimated at 0.04 g/pot rate by 37.3 and 50.1 coverage%, in first and second seasons respectively. The effects of interactions between clover cultivars and dodder seeding rates on dodder coverage percentage were statistically significant at the 5% level in all cuts and their general average in both seasons showed that under 0.02 g dodder rate infestation per pot, both Helaly & Giza 6 followed by El – Serw 1 recorded maximum reduction % ; 14.8% in the 1st and 21.5% in the 2nd season and can be described as they had some tolerance to dodder infestations and *vice versa* with Sakha 4 cultivar in the overall mean of the four cuts. Meanwhile, the differences between clover cultivars by dodder infestation had almost disappeared under high dodder seeding rates as shown in the average of the four cuts in the second season. These results were in agreement of those obtained by Narayana and Rao (1991) and El-Nahrawy *et al.* (2014) in clover.

3.2. Effect of clover cultivars, infestation rates and interaction on clover forage fresh yield in g/pot

Data in Table (2) and Fig. (2) showed that the effect of clover genotypes and different dodder infestation rates and their interactions on fresh clover yield in g/pot in the four cuts and their total yield as g/pot arrived to the level of significant at the 0.05 level in both 2016and 2017 seasons. In general, with all clover cultivars and their averages the forage yield tended to decrease consistently with increasing cut number, especially in third and fourth cuts, where Helaly and Gemmeza 1 cultivars recorded the highest forage yield g/pot in both seasons as compared with El- Serw cultivar in all cuts averages in both seasons. Increasing dodder infestation rates caused consistent reduction in the fresh weight of clover in each cut and on their total weight in both the first and the second seasons. This may be attributed to the high dodder infestation especially in the 3rd cut. The effects of interaction between clover cultivars X dodder seeding rate on the fresh forage yield of clover cultivars of all cuts and their average were statistically significant in all cuts expect with the first cut in both seasons. Under free dodder condition the highest forage yield was obtained from Helaly (97.2 g/pot) followed by Giza 6 (93.3 g/pot) and lowest yield was obtained from El Serw (60.8 g/pot) in 2015/2016 season and Gemmeza 1(123.7 g/pot) and Sakha 4 (112.5 g/pot) and the lowest yield by El Serw (100.4 g/pot). These results show that these cultivars can be grown with high yielding capacity in soil seeds free from dodder infestation. Under high dodder infestation rates; (0.04 g/pot), estimating forage yield losses of the studied cultivars under high dodder infestation of clovers as compared with the yield of free dodder infestation, the results of 2016 showed that, clover cultivars can be arranged in descending order for yield losses by Gemmeza 1 (36.2%), Helaly (52.3%), Sakha 4 (52.6%), Giza 6 (64.6%) and El Serw which highest yield losses% (64.6%), meanwhile in 2017 season Gemmeza 1 (58.12%), Helaly (55.7%), Sakha 4(67.3%), Giza 6 (67.2%) and El Serw which high yield losses% (73.9%).

Table (1): Effect of clover cultivars and dodder infestation on dodder coverage % which parasized on clover during 2015/2016- 2016/2017 seasons.

		2015/2016						2016/2017					
		Clover cuts											
Treatments													
Cultivars		**c1**	**c2**	**c3**	**c4**	**total**	**me**	**c1**	**c2**	**c3**	**c4**	**total**	**mea**
Gemmeza 1		0.0	25.0	27.7	16.4	69.1	17.3	16.4	30.7	45.7	32.2	125	31.3
Giza 6		0.0	15.7	55.7	12.8	84.1	21.0	12.8	16.3	65.3	30.7	125.1	31.3
Sakha 4		0.0	30.7	46.0	8.8	85.5	21.4	8.8	37	60.7	35.7	142.2	35.5
Helaly		0.0	33.3	45.3	8.9	87.6	21.9	8.9	44.3	47.3	56.2	156.7	39.2
El-Serw		0.0	27.7	40.7	13.8	82.2	20.5	13.8	19.3	64.7	32.7	130.5	32.6
LSD 0.05			**5.4**	**8.9**	**4.8**	**10.6**	**2.7**	**4.8**	**6.7**	**5.8**	**5.8**	**16.9**	**NS**
Dodder seeding rate													
control		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.01		0.0	15.0	23.7	8.9	47.6	11.9	5.1	30.0	50.0	28.4	113.5	28.4
0.02		0.0	31.7	41.0	13.3	86.0	21.5	19.3	23.3	50.0	30.9	123.5	30.9
0.03		0.0	39.3	70.3	15.9	125.6	31.4	17.9	50.0	56.7	42.2	166.8	41.7
0.04		0.0	46.3	80.3	22.6	149.3	37.3	40.0	50.0	71.7	53.9	215.6	53.9
LSD 0.05			6.8	10.0	3.2	11.5	2.9	0.0	0.0	0.0	0.0	0.0	0.0
Interaction													
Gemmeza1	contr	0.0	0.0	0.0	0.0	0.0	15.1	0.0	0.0	0.0	0.0	0.0	0.0
	0.01	0.0	20.0	5.0	5.1	30.1	14.5	5.1	30.0	50.0	28.4	113.5	28.4
	0.02	0.0	26.7	20.0	19.3	65.9	17.3	19.3	23.3	50.0	30.9	123.5	30.9
	0.03	0.0	25.0	50.0	17.9	92.9	0.0	17.9	50.0	56.7	42.2	166.8	41.7
	0.04	0.0	53.3	63.3	40.0	156.7	12.1	40.0	50.0	71.7	53.9	215.6	53.9
Giza 6	contr	0.0	0.0	0.0	0.0	0.0	13.2	0.0	0.0	0.0	0.0	0.0	0.0
	0.01	0.0	13.3	16.7	17.1	47.1	12.8	17.1	1.7	50.0	22.7	91.5	22.9
	0.02	0.0	21.7	71.7	15.1	108.4	6.1	15.1	10.0	83.3	36.1	144.5	36.1
	0.03	0.0	21.7	95.0	14.5	131.2	0.0	14.5	13.3	93.3	37.0	158.1	39.5
	0.04	0.0	21.7	95.0	17.3	134.0	7.9	17.3	56.7	100.0	58.0	232.0	58.0
Sakha 4	contr	0.0	0.0	0.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0
	0.01	0.0	6.7	40.0	12.1	58.7	14.0	12.1	11.7	40.0	21.3	85.1	21.3
	0.02	0.0	50.0	43.3	13.2	106.5	9.0	13.2	50.0	83.3	48.8	195.3	48.8
	0.03	0.0	56.7	73.3	12.8	142.8	0.0	12.8	50.0	90.0	50.9	203.7	50.9
	0.04	0.0	40.0	73.3	6.1	119.5	2.5	6.1	73.3	90.0	56.6	226.0	56.5
Helaly	contr	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0
	0.01	0.0	30.0	30.0	7.9	67.9	20.5	7.9	25.0	30.0	24.0	86.9	21.7
	0.02	0.0	40.0	40.0	13.8	93.8	40.8	13.8	46.7	40.0	34.2	134.7	33.7
	0.03	0.0	43.3	76.7	14.0	134.0	0.0	14.0	65.0	76.7	52.6	208.3	52.1
	0.04	0.0	53.3	80.0	9.0	142.3	5.1	9.0	85.0	90.0	61.5	245.5	61.4
EL-Serw	contr	0.0	0.0	0.0	0.0	0.0	19.3	0.0	0.0	0.0	0.0	0.0	0.0
	0.01	0.0	5.0	26.7	2.5	34.2	17.9	2.5	5.0	46.7	18.2	72.4	18.1
	0.02	0.0	20.0	30.0	5.4	55.4	40.0	5.4	10.0	80.0	31.8	127.2	31.8
	0.03	0.0	50.0	56.7	20.5	127.2	0.0	20.5	40.0	96.7	52.7	209.9	52.5
	0.04	0.0	63.3	90.0	40.8	194.1	17.1	40.8	41.7	100.0	60.8	243.3	60.8
LSD 0.05		**NS**	**15.30**	**22.42**	**7.16**	**25.76**	**6.44**	**7.16**	**17.13**	**19.71**	**8.72**	**26.87**	**6.72**

(NS not significant)

Table (2): Effect of clover cultivars and dodder infestation rates on fresh weight of clover in g/pot during two seasons.

		2015/2016						2016/2017					
		Clover cuts											
treatments													
Cultivars		**c1**	**c2**	**c3**	**c4**	**total**	**mean**	**c1**	**c2**	**c3**	**c4**	total	**mean**
Gemmeza 1		103.7	58.7	47.9	32.1	242.3	60.6	112.2	98.8	46.2	51.9	309.1	77.3
Giza 6		87.9	61.0	41.7	21.3	212.0	53.0	105.2	90.5	39.8	31.3	266.8	66.7
Sakha 4		88.1	62.0	34.0	36.9	221.0	55.3	110.6	80.8	39.9	36.9	268.2	67.1
Helaly		93.5	76.8	64.3	44.4	279.1	69.8	108.7	69.6	43.0	44.4	265.8	66.5
El-Serw		45.2	43.9	24.2	25.2	138.5	34.6	106.5	67.6	33.2	25.2	232.6	58.1
LSD 0.05		**14.1**	**12.6**	**13.0**	**14.4**	**37.2**	**9.3**	**NS**	**9.6**	**7.2**	**13.3**	**17.7**	**4.4**
Dodder seeding rate													
control		98.2	88.7	77.9	68.7	333.6	83.4	114.9	120.3	113.7	93.7	442.6	110.7
0.01		82.4	61.1	44.9	36.1	224.6	56.2	110.9	103.9	46.5	40.8	302.1	75.5
0.02		82.1	58.1	43.1	24.0	207.2	51.8	108.6	79.7	21.2	27.0	236.4	59.1
0.03		80.3	46.7	29.3	19.0	175.3	43.8	109.6	61.6	11.8	17.6	200.6	50.2
0.04		75.2	47.8	16.9	12.2	152.1	38.0	99.3	41.8	9.0	10.7	160.8	40.2
LSD 0.05		**10.3**	**8.0**	**9.8**	**11.5**	**22.5**	**5.6**	**9.6**	**9.7**	**6.9**	**11.5**	**18.7**	**4.7**
Interaction													
Gemmeza 1	control	111.4	74.7	80.0	55.5	321.6	80.4	111.2	133.7	111.0	138.8	494.7	123.7
	0.01	105.2	56.7	44.2	29.8	235.8	59.0	113.4	116.3	56.3	59.8	345.8	86.4
	0.02	96.7	57.8	49.6	30.8	234.9	58.7	119.5	104.4	16.7	30.8	271.5	67.9
	0.03	103.8	49.1	37.0	24.1	214.0	53.5	113.8	74.6	20.9	17.3	226.7	56.7
	0.04	101.2	55.2	28.5	20.4	205.3	51.3	103.2	64.9	26.2	12.7	207.0	51.8
Giza 6	control	92.2	119.7	92.0	69.4	373.2	93.3	108.9	114.0	110.8	111.2	444.9	111.2
	0.01	87.8	69.6	69.0	35.4	261.7	65.4	100.1	116.6	48.4	28.7	293.8	73.5
	0.02	84.8	50.0	41.9	1.7	178.4	44.6	105.0	90.2	27.1	16.7	239.0	59.8
	0.03	86.3	28.3	0.0	0.0	114.6	28.6	103.1	82.8	12.8	0.0	198.8	49.7
	0.04	88.7	37.6	5.8	0.0	132.0	33.0	108.7	48.8	0.0	0.0	157.5	39.4
Sakha 4	control	109.0	87.3	76.1	68.7	341.1	85.3	124.8	129.9	126.7	68.7	450.1	112.5
	0.01	85.7	69.9	31.5	59.6	246.7	61.7	121.9	109.0	54.1	59.6	344.6	86.2
	0.02	85.0	55.5	30.9	17.4	188.9	47.2	101.8	66.9	17.6	17.4	203.7	50.9
	0.03	85.7	48.9	14.8	17.4	166.9	41.7	114.8	62.8	0.0	17.4	195.0	48.8
	0.04	75.1	48.2	16.8	21.5	161.5	40.4	89.8	35.4	1.0	21.5	147.7	36.9
Helaly	control	115.2	98.1	88.9	86.8	388.9	97.2	110.3	110.3	114.3	86.8	421.7	105.4
	0.01	91.3	63.6	50.6	22.4	227.9	57.0	112.0	80.7	31.3	22.4	246.4	61.6
	0.02	105.5	96.6	85.2	49.8	337.1	84.3	109.5	57.1	28.6	49.8	245.0	61.2
	0.03	82.7	63.4	69.6	44.1	259.8	65.0	108.9	53.1	23.1	44.1	229.2	57.3
	0.04	72.7	62.5	27.3	19.2	181.7	45.4	102.8	46.9	17.9	19.2	186.9	46.7
El-Serw	control	63.4	63.8	52.6	63.2	243.0	60.8	119.1	113.8	105.6	63.2	401.7	100.4
	0.01	42.1	46.1	29.3	33.5	151.0	37.7	106.9	97.0	42.6	33.5	280.1	70.0
	0.02	38.5	30.4	7.7	20.1	96.8	24.2	107.1	79.7	15.7	20.1	222.7	55.7
	0.03	43.3	43.8	25.1	9.2	121.4	30.4	107.2	34.8	2.2	9.2	153.4	38.4
	0.04	38.6	35.4	6.1	0.0	80.2	20.0	92.0	12.9	0.0	0.0	104.9	26.2
LSD0.05		**NS**	**18.0**	**21.9**	**25.6**	**50.3**	**12.6**	**NS**	**21.7**	**15.4**	**25.6**	**41.8**	**10.4**

(NS not significant)

These results emphasized the fact that Gemmeza 1 followed by Helaly were more tolerant than the other clover cultivars and El-Serw can be considered as susceptible cultivar. These results are confirmed by Al- Menoufi and Hassan (1977) and El-Nahrawy *et al.* (2014).

3.3. Effect of clover cultivars, dodder seeding rates and their interaction on dry weight clover forage

Data in Table (3) and Fig. (3) showed that clover cultivars Gemmeza 1, Giza 6, Sakha 4 and Helaly significantly exceeded El-Serw

Table (3): Effect of clover cultivars , dodder seedingand interaction on dry weight of clover on yield during two seasons.

		2015/2016						2016/2017					
Clover cuts													
Treatments													
Cultivars		**c1**	**c2**	**c3**	**c4**	**total**	**mean**	**c1**	**c2**	**c3**	**c4**	**total**	**mean**
Gemmeza 1		19.7	12.1	5.5	6.8	44.1	11.0	20.0	19.9	9.5	16.6	66.0	16.5
Giza 6		20.3	6.9	6.3	3.4	36.9	9.2	21.3	18.4	11.3	17.0	68.0	17.0
Sakha 4		21.1	11.8	6.5	6.8	46.2	11.5	23.0	16.5	7.8	15.8	63.1	15.8
Helaly		21.6	9.3	7.6	12.6	51.1	12.8	21.8	14.8	8.9	16.0	61.5	15.4
El-Serw		10.7	8.6	3.8	5.5	28.6	7.1	21.4	13.6	8.0	14.4	57.4	14.4
LSD 0.05		**5.3**	**3.3**	**2.2**	**3.7**	**10.6**	**2.7**	**1.2**	**1.4**	**2.1**	**3.9**	**4.7**	**1.2**
Dodder seeding rate													
control		19.7	13.9	12.0	12.6	58.3	14.6	24.6	24.2	22.8	24.0	95.6	23.9
0.0		18.5	11.2	6.4	8.0	44.1	11.0	21.7	20.8	12.5	18.3	73.3	18.3
0.0		19.7	7.6	4.0	6.3	37.6	9.4	20.5	16.2	5.0	13.6	55.3	13.8
0.0		17.3	7.6	4.2	5.3	34.4	8.6	20.5	12.6	2.7	12.0	47.8	12.0
0.0		18.1	8.5	3.0	2.9	32.5	8.1	20.3	9.5	2.6	10.8	43.2	10.8
LSD 0.05		**NS**	**2.2**	**2.1**	**2.7**	**5.0**	**1.3**	**2.0**	**1.9**	**2.2**	**2.7**	**4.1**	**1.0**
Interaction													
Gemmeza 1	control	27.1	16.9	15.5	9.8	69. 3	17.3	28.7	26.2	19.3	25.4	99.6	24.9
	0.0	18.6	11.8	3.3	6.2	39.9	10.0	18.6	23.1	12.0	17.9	71.6	17.9
	0.0	18.1	9.3	3.4	7.5	38.2	9.6	18.1	20.4	2.8	13.8	55.1	13.8
	0.0	14.8	10.7	1.1	4.9	31.5	7.9	14.8	16.0	4.6	11.8	47.2	11.8
	0.0	19.9	11.8	4.4	5.6	41.7	10.4	19.9	13.8	9.0	14.3	57.0	14.3
Giza 6	control	17.2	9.5	11.6	11.9	50.2	12.6	22.3	22.5	21.0	21.9	87.7	21.9
	0.0	21.2	7.1	13.0	4.6	46.0	11.5	20.8	22.5	23.3	22.0	88.6	22.2
	0.0	20.5	5.5	4.1	0.4	30.5	7.6	21.0	18.2	8.7	16.0	63.9	16.0
	0.0	20.9	6.6	0.0	0.0	27.5	6.9	20.6	16.3	3.4	13.4	53.7	13.4
	0.0	21.5	5.9	3.0	0.0	30.4	7.6	21.8	12.8	0.0	11.5	46.1	11.5
Sakha 4	control	21.6	17.4	15.8	10.9	65.7	16.4	26.0	26.2	25.0	25.7	102.9	25.7
	0.0	20.8	12.1	3.9	12.4	49.2	12.3	25.1	21.9	10.6	19.2	76.8	19.2
	0.0	20.7	6.8	3.9	3.5	34.9	8.7	20.8	14.0	3.4	12.7	50.9	12.7
	0.0	20.8	10.3	4.8	3.6	39.5	9.9	23.6	12.9	0.0	12.2	48.7	12.2
	0.0	21.6	12.1	3.9	3.9	41.4	10.4	19.5	7.3	0.2	9.0	36.0	9.0
Helaly	control	21.8	12.7	11.2	17.8	63.4	15.9	21.8	22.7	23.2	22.6	90.3	22.6
	0.0	22.1	14.7	5.0	9.9	51.8	12.9	22.4	16.7	6.6	15.2	60.9	15.2
	0.0	26.5	9.6	6.4	16.4	58.9	14.7	22.3	12.2	5.8	13.4	53.7	13.4
	0.0	20.0	4.5	12.5	13.7	50.7	12.7	22.3	10.9	5.2	12.8	51.2	12.8
	0.0	17.5	5.1	2.9	5.0	30.5	7.6	20.4	11.3	3.7	11.8	47.2	11.8
EL-Serw	control	11.0	13.0	6.1	12.7	42.7	10.7	23.9	23.3	25.3	24.2	96.7	24.2
	0.0	9.8	10.1	6.7	6.9	33.5	8.4	21.5	19.7	10.1	17.1	68.4	17.1
	0.0	12.7	6.6	2.4	3.8	25.6	6.4	20.5	16.1	4.4	13.7	54.7	13.7
	0.0	9.8	5.8	2.8	4.2	22.6	5.6	21.3	6.8	0.4	9.5	38.0	9.5
	0.0	10.1	7.5	0.9	0.0	18.5	4.6	19.9	2.3	0.0	7.7	29.9	7.5
LSD 0.05		**NS**	**NS**	**4.7**	**NS**	**11.2**	**2.8**	**4.6**	**4.3**	**5.0**	**NS**	**9.1**	**2.3**

(NS not significant)

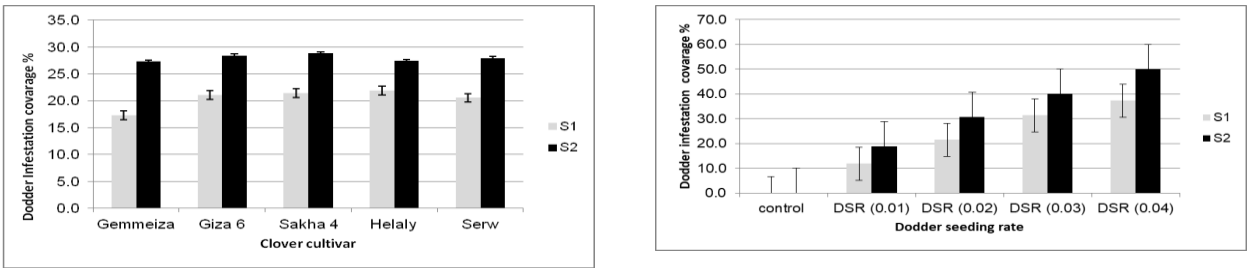

Fig. (1): Effect of clover cultivars, dodder infestation and their interaction on dodder growth during two seasons.

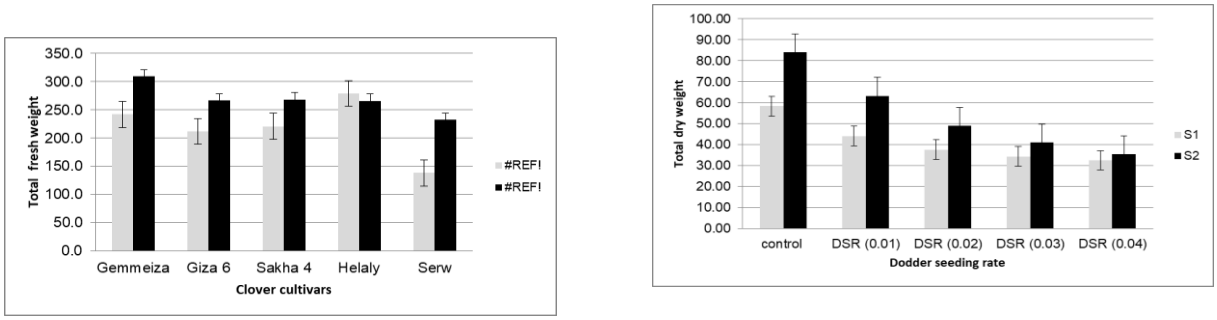

Fig.(2): Effect of clover cultivars and dodder infestation on Fresh weight during two seasons.

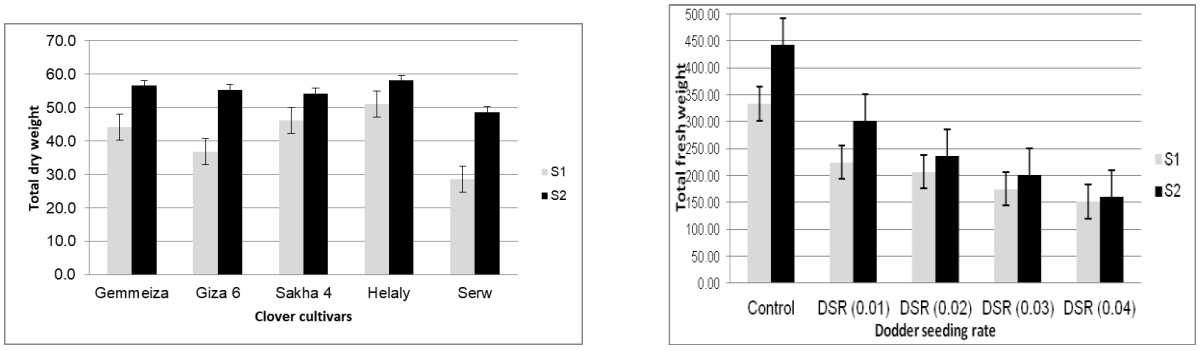

Fig. (3): Effect of clover cultivars, dodder infestation rates and their interaction on clover dry weight during two seasons.

cultivar in their dry weight g/pot in all cuts or their general mean with some exceptions in both 2015/2016 and 2016/2017 seasons. In 2015/2016, the clover cultivars can be arranged in descending order as Helaly, Sakha 4, Gemmeza 1 increased dry forage yield /pot by 80.3, 61.97and 54.93% than El-Serw cultivar; respectively and Helaly, Gemmeza 1 by12.9 and 15.6 % than El- Serw cultivar in 2016/2017 season respectively. On the other hand, increasing dodder infestation rates from 0.01 to 0.04 gram/pot caused drastic and sharp reduction in clover dry weight than the control treatment (free dodder infestation).

The effect of the interaction between clover cultivar X seeding rates on clover dry weight of the 1^{st} &the 2^{nd} & the 4^{th} cuts in 2015/2016 season and 4^{th} cut in 2016/2017 season did not arrive to the level of significance, meaning that the two studied factors were independent. Meanwhile, the average mean of cuts reached the level of significant in 2015/2016 season and the 1^{st} & the 2^{nd} & the 3^{rd} cuts and the average means of cuts reached to the level of significance.

Under non infestation condition the dry weight of Gemmeza 1, Giza 6, Sakha 4 and Helaly were similar in dry weight yield and exceeding significant in dry weight yield and exceeding significantly by El- Serw except with Sakha 4 in the first season and without significant differences in dry matter yield in second season, indicating that such cultivar can grow very well under non dodder infestation condition. But, under dodder infestation the day matter yield tended to decrease significantly with some variation among cultivars, with some degree of tolerance to dodder infestation except with El- Serw cultivar which is categorized as susceptible to dodder infestation. These results confirmed that obtained by Abd-El Halim *et al.* (1998).

3.4. Effect of clover cultivars, dodder infestation rates and their interaction on clover stem weight g/plant

The effects of clover cultivars and dodder infestation rates on clover stem weight in both studied seasons are shown in Table (4) and Fig. (4). The weight of clover plant stem as affected by clover genotypes did not reach the 5% significant level in all cuts or their total mean in both seasons in general mean except with the first cut in the first season where Giza 6 cultivar recorded the highest stem weight per plant. The effect of various infestation rates of dodder on the weight of the stem per plant were statistically significant in all clover cuts and was true in both seasons. The trend showed that the weight of stem of clover plant tended to decline sharply with increasing dodder seeding rate from 0.01 to 0.04g of dodder seeds /pot.

The effects of interaction between clover cultivar X seeding rates were not significant on stem weight per pot in all cuts except with 1^{st} &3rd cuts in 2015/2016 season and 3^{rd} & 4^{th} cuts in 2016/2017 season in general mean which arrived to the level of significant at 5% level. This result pointed clearly to the susceptibility of El -Serw cultivar to dodder infestation.

3.5. On stem length

Table (5) and Fig. (5) showed the effect of clover cultivars, dodder seeding rates and their interaction on stem length of clover cultivars. The effect of clover cultivars were not statistically significant on stem length except in cut no2 and no 4 in the 1^{st} season and all cuts in second season which arrived only to the level of significant at 5%level. In general, the highest stem length was achieved with Gemmeza 1 and vice versa with El-Serw which recorded the lowest value of stem length.

The effect of dodder seeding infestation rates caused consistent and significant decrease on stem length with increasing infestation rates in all clover cuts or their average means in both the 1^{st} and 2^{nd} seasons. Similar results were mentioned by (Al-Menoufi& Hassan,1977; Al-Menoufi *et al.* 1985; Abd El-Hamid & El-Khanagry, 2006; Goldwasser *et al.*, 2001).

The effect of interaction between clover cultivar X dodder seeding rate on stem length were not statistically significant in all cuts and general mean except with 2^{nd} ,3^{rd} cuts and overall means which arrived to the level of significant at 5% level in 1^{st} season and from their interaction in 2016/2017 season under free dodder condition, Gimmeza 1 and Sakha 4 were significantly superior than El-Serw cultivar in stem length.

3.6. Effect on number of leaves /plant

The effects of clover cultivar, dodder seeding rates and their interaction on the number of leaves /clover plant in both studied seasons are shown in in Table (6) and Fig.(6). Number of clover leaves / plant did not differ significantly in both seasons as affected by clover cultivars expect with 3^{rd} cut in 2015/2016 and 2016/2017 which show that Helaly cultivar exerted highest mean value meanwhile, El-Serw cultivar recorded the lowest value of number of clover leaves / plants. Increasing dodder seeding rates

Table (4): Effect of clover cultivars, dodder infestation rate and their interaction on the weight of the stem (g/pot) on dodder growth during two seasons.

		2015/2016						2016/2017					
Clover cuts													
Treatments													
Cultivars		**c1**	**c2**	**c3**	**c4**	**total**	**mean**	**c1**	**c2**	**c3**	**c4**	**total**	**mea**
Gemmeza 1		5.6	8	6.2	3.1	22.9	5.7	6.6	6.1	4.4	5	22.1	5.5
Giza 6		13	6.4	5.9	3.8	29.1	7.3	7.6	6.3	3.7	5.4	23	5.7
Sakha 4		4.7	6.6	6	5.4	22.8	5.7	6.5	5.6	5.5	6.5	24.1	6.0
Helaly		5.1	6.3	8	4.7	24.1	6	6	5.4	4.9	5.8	22.1	5.5
El-Serw		8.6	7.7	4.7	4	25	6.3	7.5	6.2	4.4	6.2	24.3	6.1
LSD 0.05		**2.3**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Dodder seeding rate													
control		8.3	9.3	12.3	7	36.9	9.2	7.3	8.6	9.8	8.6	34.3	8.6
0.01		8.9	8.8	6	5	28.7	7.2	6.8	7.2	6	7.3	27.3	6.8
0.02		7.3	5.8	5.4	4.1	22.7	5.7	7.2	5.6	3.9	5.9	22.6	5.6
0.03		6.8	6.1	4.1	2.8	19.7	4.9	6.5	4.5	1.8	4.6	17.4	4.3
0.04		5.7	5	3.2	2.1	15.9	4	6.4	3.8	1.4	4.1	15.7	3.9
LSD 0.05		**1.4**	**2.4**	**2.1**	**2.5**	**5**	**1.3**	**NS**	**1**	**1.3**	**1.8**	**2.7**	**0.7**
Interaction													
Gemmeza1	control	6	12	12.4	3.3	33.7	8.4	6.6	7.5	7.2	7.1	28.4	7.1
	0.01	6.7	10.1	3.2	2.6	22.5	5.6	6	6.1	5.8	5.4	23.3	5.8
	0.02	7	5.8	6.7	3.5	23.1	5.8	6.8	6.8	2.8	7.4	23.8	6.0
	0.03	5.3	6.4	4	3.8	19.5	4.9	7	5.2	2	4.7	18.9	4.7
	0.04	3	5.5	4.9	2.4	15.8	4	6.5	4.7	4.1	5.1	20.4	5.1
Giza 6	control	10	8.5	11.9	7	37.4	9.3	7.4	9.2	9.5	8.7	34.8	8.7
	0.01	11.3	6.7	10.3	8.8	37.1	9.3	8.3	7.8	5.6	7.2	28.9	7.2
	0.02	13	6.2	6.1	3.2	28.4	7.1	8.2	5.7	2.3	5.4	21.6	5.4
	0.03	14.7	5.5	0	0	20.2	5.1	7.2	5.3	1	4.5	18.0	4.5
	0.04	16.2	4.9	1.4	0	22.4	5.6	7	3.5	0	3.5	14.0	3.5
Sakha 4	control	8	7.4	12.4	11.2	39	9.8	7.3	8.7	14.7	10.2	40.9	10.2
	0.01	7	7.5	4.7	8.6	27.8	7	6.9	7	6.1	10	30.0	7.5
	0.02	3	6.3	5.7	2.5	17.4	4.4	6.3	4.6	5.1	5.3	21.3	5.3
	0.03	2.3	7.5	5	0.8	15.6	3.9	5.8	4.4	0	3.4	13.6	3.4
	0.04	3.3	4.4	2.5	4.1	14.4	3.6	6.3	3.5	1.7	3.8	15.3	3.8
Helaly	control	7	10.1	14.4	6.1	37.6	9.4	6.3	8.7	7.3	7.4	29.7	7.4
	0.01	6.7	9.1	4.5	1.1	21.3	5.3	6.3	7.6	5.1	6.3	25.3	6.3
	0.02	5	4.3	6.8	7.2	23.3	5.8	6.2	4.2	5.2	5.2	20.8	5.2
	0.03	4	4.9	8.1	4.9	22	5.5	5.6	3.9	5.7	6.8	22.0	5.5
	0.04	3	3.1	6	4	16	4	5.5	2.7	1.2	3.1	12.5	3.1
El-Serw	control	10.7	8.4	10.3	7.3	36.6	9.2	9	9	10.3	9.4	37.7	9.4
	0.01	13	10.8	7.3	3.8	34.8	8.7	6.7	7.4	7.3	7.1	28.5	7.1
	0.02	8.7	6.5	1.7	4.3	21.2	5.3	8.5	6.8	3.9	6.3	25.5	6.4
	0.03	7.7	5.9	3.2	4.5	21.3	5.3	6.9	3.5	0.5	3.5	14.4	3.6
	0.04	3	7.1	1	0	11.1	2.8	6.5	4.4	0	4.3	15.2	3.8
LSD 0.05		**3.1**	**NS**	**4.66**	**NS**	**NS**	**NS**	**NS**	**NS**	**3**	**4**	**6.1**	**1.5**

(NS not significant)

Table (5): Effect of clover cultivars and length of stem on dodder growth during two seasons.

		2015/2016						2016/2017					
		Clover cuts											
Treatments													
Cultivars		**c1**	**c2**	**c3**	**c4**	**total**	**mean**	**c1**	**c2**	**c3**	**c4**	**total**	**mean**
Gemmeza 1		23.6	23.6	23.9	27.0	98.0	24.5	34.3	31.4	17.9	26.8	110.4	27.6
Giza 6		26.9	26.4	22.1	10.9	86.3	21.6	30.9	28.1	17.2	11.9	88.1	22.0
Sakha 4		23.2	22.3	21.6	24.2	91.3	22.8	32.6	29.4	17.9	24.2	104.1	26.0
Helaly		24.3	23.3	28.4	15.1	91.1	22.8	32.3	25.6	25.2	15.1	98.2	24.6
El-Serw		22.4	20.7	16.0	17.5	76.6	19.1	30.7	25.8	10.9	17.5	84.9	21.2
LSD 0.05		**NS**	**2.2**	**NS**	**8.4**	**NS**	**NS**	**2.4**	**4.0**	**2.7**	**7.1**	**6.7**	**1.7**
Dodder seeding rate													
control		27.9	28.2	35.5	28.1	119.7	29.9	33.7	37.5	33.7	29.0	133.9	33.5
0.01		27.6	26.5	26.4	23.1	103.6	25.9	32.9	30.8	21.5	23.9	109.0	27.3
0.02		25.0	22.9	22.4	17.1	87.4	21.8	30.3	26.3	16.2	18.0	90.8	22.7
0.03		20.9	20.9	14.5	15.1	71.4	17.8	32.4	23.5	9.6	13.7	79.1	19.8
0.04		18.9	17.7	13.1	11.4	61.2	15.3	31.5	22.2	8.0	11.1	72.8	18.2
LSD 0.05		**3.4**	**2.9**	**6.2**	**6.7**	**13.6**	**3.4**	**2.3**	**3.1**	**4.1**	**5.7**	**9.4**	**2.4**
Interaction													
Gemmeza 1	contr	26.2	26.0	36.9	33.6	122.8	30.7	35.5	40.0	32.7	38.0	146.1	36.5
	0.01	25.3	25.1	29.6	30.0	110.1	27.5	33.9	32.7	19.0	34.0	119.6	29.9
	0.02	25.4	26.0	26.3	27.7	104.7	26.2	31.0	30.3	11.0	27.0	99.4	24.8
	0.03	21.5	21.1	13.0	28.3	84.4	21.1	36.9	29.4	11.0	21.3	98.6	24.7
	0.04	19.5	20.0	13.8	15.1	68.0	17.0	34.3	24.7	15.8	13.7	88.4	22.1
Giza 6	contr	32.2	32.1	40.0	26.3	130.7	32.7	32.2	39.5	36.9	26.3	134.9	33.7
	0.01	32.9	33.0	39.7	18.3	123.9	31.0	32.9	30.9	26.3	18.3	108.4	27.1
	0.02	25.4	25.0	21.7	10.0	82.4	20.6	25.4	27.2	15.0	15.0	82.6	20.6
	0.03	24.5	24.0	0.0	0.0	49.0	12.3	31.2	23.8	7.7	0.0	62.7	15.7
	0.04	19.4	17.1	8.9	0.0	45.3	11.3	32.7	19.3	0.0	0.0	52.1	13.0
Sakha 4	contr	31.5	31.8	33.2	33.7	129.8	32.5	35.0	40.7	35.1	33.7	144.5	36.1
	0.01	28.0	27.3	21.0	35.0	111.3	27.8	30.8	33.7	25.5	35.0	124.9	31.2
	0.02	23.3	23.3	21.9	9.3	77.9	19.5	30.0	25.3	22.3	9.3	87.0	21.7
	0.03	14.8	14.5	17.6	17.0	63.9	16.0	35.1	22.3	0.0	17.0	74.4	18.6
	0.04	18.3	14.8	14.4	26.0	73.5	18.4	32.0	25.0	6.7	26.0	89.7	22.4
Helaly	contr	27.6	25.3	39.1	19.7	111.7	27.9	33.0	31.7	37.1	19.7	121.4	30.4
	0.01	29.6	28.5	24.0	10.3	92.4	23.1	33.3	27.3	19.0	10.3	90.0	22.5
	0.02	26.0	24.4	29.4	18.3	98.1	24.5	35.3	26.5	26.1	18.3	106.2	26.6
	0.03	19.6	19.1	25.9	11.7	76.8	19.2	30.3	21.5	26.1	11.7	89.6	22.4
	0.04	18.6	18.0	23.6	15.7	76.5	19.1	29.3	21.1	17.7	15.7	83.8	21.0
El-Serw	contr	22.3	25.7	28.2	27.3	103.5	25.9	33.0	35.7	26.5	27.3	122.5	30.6
	0.01	22.1	18.5	18.0	21.7	80.2	20.1	33.3	29.3	18.0	21.7	102.3	25.6
	0.02	24.8	16.2	12.6	20.3	73.9	18.5	29.7	22.3	6.8	20.3	79.1	19.8
	0.03	24.0	24.2	16.1	18.3	82.8	20.7	28.3	20.7	3.1	18.3	70.4	17.6
	0.04	18.7	18.8	5.0	0.0	42.5	10.6	29.0	21.0	0.0	0.0	50.0	12.5
LSD 0.05		**NS**	**6.5**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**9.2**	**12.7**	**21.0**	**5.3**

(NS not significant)

Table (6): Effect of clover cultivars and dodder seeding rates on the number of clover per plant of leaves on dodder growth during two seasons.

		2015/2016						2016/2017					
Clover Cultivars													
Treatments													
Cultivars		c1	c2	c3	c4	total	mean	c1	c2	c3	c4	total	mean
Gemmeza 1		32.9	34.4	20.6	20.9	108.8	27.2	32.3	30.7	20.4	27.7	111.1	27.8
Giza 6		34.5	29.9	19.6	10.5	94.6	23.7	37.2	32.1	20.7	30	120.0	30.0
Sakha 4		28.6	32.1	17.5	20.3	98.5	24.6	32.7	30.9	15.9	26.3	105.8	26.5
Helaly		30.1	30.9	27.7	18.6	107.2	26.8	32.5	27.3	23.8	27.9	111.5	27.9
El-Serw		29.9	30.5	17.5	21.3	99.1	24.8	30.3	25.3	11.7	22.4	89.7	22.4
LSD 0.05		**NS**	**NS**	**2.8**	**NS**	**NS**	**NS**	**1.3**	**0.5**	**1.8**	**NS**	**NS**	**NS**
Dodder seeding rate													
control		32.9	34.4	34.2	33.1	134.7	33.7	36.4	36.1	32.5	35	140.0	35.0
0.01		32.9	32.3	21.5	18.6	105.2	26.3	33.5	32.5	23.1	29.6	118.7	29.7
0.02		32.7	30.1	21	18.5	102.4	25.6	33	28	17.5	26.6	105.1	26.3
0.03		31.9	32.1	14	12.3	90.3	22.6	32.6	26.1	11.1	21.9	91.7	22.9
0.04		25.4	28.8	12.3	9.1	75.6	18.9	29.5	23.5	8.4	20.4	81.8	20.5
LSD 0.05		**1.7**	**1.7**	**2.9**	**3.2**	**5.7**	**1.4**	**1.5**	**1.2**	**2.5**	**2.8**	**4.9**	**1.2**
Interaction													
Gemmeza 1	control	39.3	34.3	34.3	32	140	35	33.7	38	24.3	32	128.0	32.0
	0.01	36	38.3	16.7	26	117	29.3	35.3	33.3	21.3	30	119.9	30.0
	0.02	33.3	33.7	23.3	24	114.3	28.6	30.3	31	18.3	26.5	106.1	26.5
	0.03	29	34.3	15.1	13.3	91.8	22.9	30.3	26.3	17.7	24.4	98.7	24.7
	0.04	26.7	31.3	13.6	9.3	81	20.2	32	24.7	20.3	25.7	102.7	25.7
Giza 6	control	36	34	38.7	31.3	140	35	39.3	37.3	38.3	33.3	148.2	37.1
	0.01	35	30.3	33.3	8.7	107.3	26.8	37.3	35.7	33.3	35.4	141.7	35.4
	0.02	31	27.3	25.3	12.7	96.3	24.1	37.7	30	22	29.9	119.6	29.9
	0.03	40.3	33	0	0	73.3	18.3	38	28.7	10	25.6	102.3	25.6
	0.04	30.3	25	0.8	0	56.2	14	33.7	28.7	0	20.8	83.2	20.8
Sakha 4	control	33.7	36	29	36.7	135.3	33.8	35	38.7	34.3	36	144.0	36.0
	0.01	31	28.3	15.7	21.9	96.9	24.2	32.3	37.3	20	30	119.6	29.9
	0.02	32.3	33	15.7	8.7	89.7	22.4	32	28.7	19.7	26.6	107.0	26.8
	0.03	27.3	34	11.3	12.7	85.3	21.3	32.7	27.7	0	20.1	80.5	20.1
	0.04	18.7	29	16	21.7	85.3	21.3	31.7	22	5.7	19.6	79.0	19.8
Helaly	control	28.7	38.3	37.3	29.3	133.7	33.4	37.3	37	35.7	36.7	146.7	36.7
	0.01	31.7	34.3	21.3	11.3	98.7	24.7	31.7	30	20.7	27.5	109.9	27.5
	0.02	33.7	27.3	30.5	23.3	114.8	28.7	31.7	25.7	23.7	27.5	108.6	27.2
	0.03	29.7	29.3	26.2	14.3	99.5	24.9	35	24	23	26	108.0	27.0
	0.04	26.7	25	23	14.7	89.3	22.3	26.7	19.7	16	20.8	83.2	20.8
El-Serw	control	27	29.3	31.7	36.3	124.3	31.1	36.7	29.3	30	32	128.0	32.0
	0.01	31	30	20.3	25	106.3	26.6	31	26	20.3	25.7	103.0	25.8
	0.02	33.4	29.3	10	24	96.7	24.2	33.4	24.7	3.7	20.6	82.4	20.6
	0.03	33.3	30	17.3	21	101.7	25.4	27	24	4.7	18.6	74.3	18.6
	0.04	24.7	33.7	8	0	66.3	16.6	23.3	22.7	0	15.3	61.3	15.3
LSD 0.05		**NS**	**NS**	**6.4**	**NS**	**NS**	**NS**	**NS**	**NS**	**5.5**	**6.3**	**NS**	**NS**

(NS not significant)

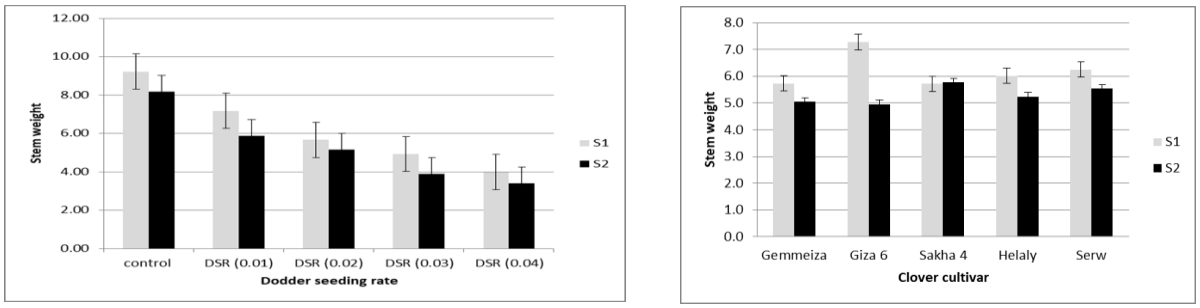

Fig. (4): Effect of clover cultivars and the weight of stem on dodder growth during two seasons.

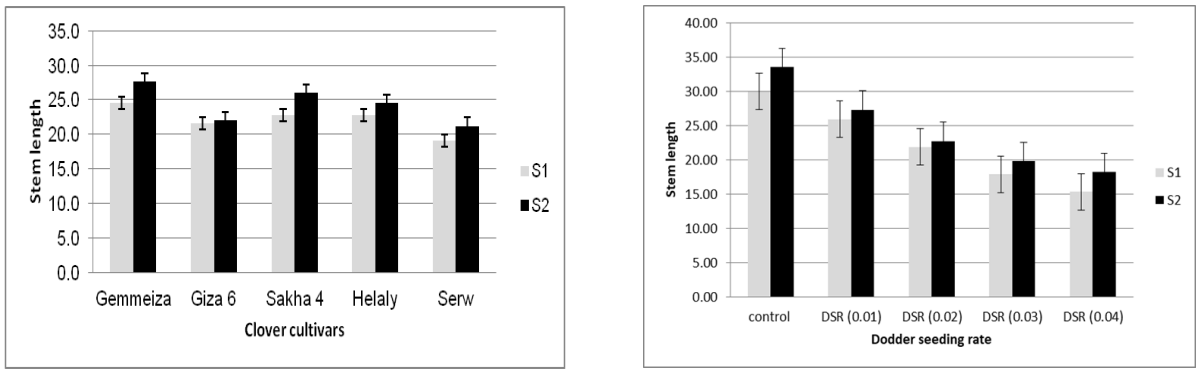

Fig. (5): Effect of clover cultivars and the length of stem on dodder growth during two seasons.

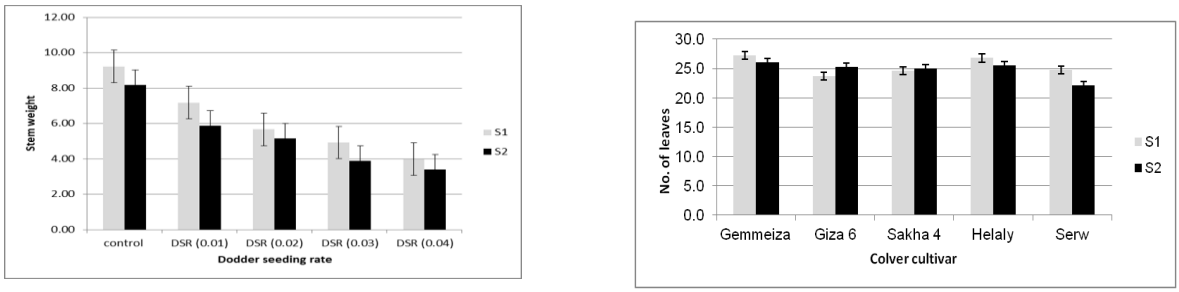

Fig. (6): Effect of clover cultivars and no. of leaves on dodder growth during two seasons.

caused consistent and significant decreases in number of clover leaves /plant. These results were true in all cuts and average of cuts in both studied seasons, which are mainly attributed to the decrease of chlorophyll contents mentioned by (El-Nahrawy, 2014). Significant interactions were noticed between the effect of clover cultivars X dodder seeding rates on number clover leaves /plant on the general average, meaning that the two studied factors act independent.

3.7. Estimation of clover cultivars tolerance to dodder infestation

Results in Table (7) showed that Gemmeza 1 can tolerate light and medium infestation rates of dodder which had high tolerant index and almost varied from 70-73% in both seasons, while Sakha 4 had tolerant index varied from 70-76.2% under light dodder seeding rate (0.01g/pot). Such tolerance in clover cultivars may be explained by different mechanisms as mentioned by Abd El Wahed (1996) and Zaki *et al., (*1998) and El Refaey *et al , (*2014). They state that the reaction of dodder with clover stem of tolerant clover cultivar had darkness in the tissue which stop dodder haustoria penetration in the stem and contrary to susceptible clover genotypes where in trues cells of dodder can penetrate easily to center and host vascular tissue, meanwhile Serw cultivar had low tolerant index tolerant (26.1 to 32.9%). Thus, the technique which adopted from Hassanein *et al.,* (1998) to measure the tolerance of faba bean to *Orobanchae* can be used to measure tolerant index of clover to dodder infestation can be used successfully as rapid technique to screen tolerant clover cultivar to dodder under artificial dodder infestation condition in pot experiments to avoid non homogeneous dodder infestation under field conditions.

Table (7): Dodder index tolerance % of clover cultivars to dodder infestation under various dodder infestation levels as average of four cuts during2015/2016-2016/2017seasons.

Clover cultivar Cut	Dodder seeding rate infestation level (g/pot)				
	0	0.01	0.02	0.03	0.04
Tolerance%					
2015/2016					
Gemmeza 1	100	73.4	73	66.5	63.8
Giza 6	100	70	47.8	30.6	35.4
Sakha4	100	72.3	55.3	48.5	47.4
Helaly	100	58.6	41.2	66.9	46.9
Serw	100	62	39.8	50	32.9
2016/2017					
Gemmeza 1	100	69.8	54.9	45.8	41.9
Giza 6	100	66.1	53.8	44.7	36
Sakha4	100	76.2	45.3	44.4	32.7
Helaly	100	58.5	58.1	53.4	44.4
El-Serw	100	69.4	55.5	38.2	26.1

100: Immune, 100: Resistant, 90-70: Tolerant, 60: Moderately tolerant, 50-30: Susceptible and 20-0: Very Susceptible.

Conclusion

The results of this investigation clearly showed that dodder parasitism in clover is considered as one of major biotic stresses which decrease clover forage yield by 54.4 - 63.7% depending on clover cultivar tolerance or the level of dodder infestation. For example Gemmeza 1 and Giza 6 tolerance indices were 73.4 and 72.3 %.

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أداء بعض أصناف البرسيم المصرى كمحصول علف ومدى تحملها الأصابة بالحامول

مها فهيم العنانى - ايهاب محمد زايد*

المعمل المركزى لبحوث الحشائش - *قسم الخلية – معهد المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – مصر.

ملخص

تعتبر الإصابه بحشيشة الحامول المتطفلة هى المشكلة الرئيسية والتى تسبب فقدا كبيرا فى محصول البرسيم المصرى كمحصول علف أخضر خصوصا فى الحشتين الثالثة والرابعة مصحوبا بتلوث بذور البرسيم الناتجة ببذورالحامول وذلك نظرا لتماثلهما فى الحجم والشكل. لهذا هدفت الدراسة الحالية إلى تقدير حجم الفقد فى المحصول الذى أصابه تطفل الحامول و كذلك تقدير مدى تحمل بعض أصناف البرسيم المصرى الهامه للأصابة بالحامول . وذلك كهدف هام لمربى محصول البرسيم لانتخاب بعض اصناف البرسيم ذات تحمل للأصابة بالحامول. لهذا اجريت هذه التجارب لمعرفة درجة حساسية او تحمل خمس أصناف من البرسيم للأصابة بالحامول والتى أحضرت تقاويها من قسم بحوث العلف بمعهد المحاصيل الحقلية وهى اصناف الجميزة 1 و جيزة 6 وسخا 4 وهلالى والسرو1. تم اختيار الاصناف تحت خمس مستويات من العدوى الصناعية ببذور الحامول وهى صفر ، 0.01 ، 0.02 ، 0.03 ، 0.04 جم / أصيص فى تجربتين بالاصص بالصوبة السلكية بالمعمل المركزى لبحوث الحشائش بالجيزة أثناء موسمى 2016/2015 و 2017/2016فى نظام القطاعات الكاملة العشوائية، وذلك نظرا لصعوبة تقييم درجة تحمل سلالات البرسيم فى الحقل الطبيعى لعدم تجانس الاصابة . شملت كل تجربة عدد 25 معاملة فى التوليفات من الأصناف ومعدلات العدوى ببذور الحامول. وكانت القراءات المأخوذة هى النسبة المئوية للتغطية بالحامول فى الأصيص، ووزن محصول العلف الغض، والجاف للأصيص، بالأضافة إلى قياس درجة تحمل أصناف البرسيم للأصابة بالحامول و درجة الفقد فى محصول البرسيم تحت مستويات العدوى بالحامول بمقدار 32.6، 37.9 ،47.5 و54.4 % فى موسم2016/2015 وكذلك 31.8، 46.6، 54.6 و63.7% فى موسم 2017/2016 مقارنة بالمحصول الخالى من الأصابة بالحامول على التوالى. كما أظهرت الدراسة ان الحامول يبدأ فى الظهور إبتدا من الحشة الثانية وقد تظهر فى الحشة الأولى وتصل ذروة الاصابة به فى الحشتين الثانية والثالثة وتنخفض فى الحشة الرابعة والتى يعود إليها بنقص المادة الجافة للبرسيم فى هاتين الحشتينن. كما أدت زيادة العدوى ببذور الحامول إلى أحداث نقص مستمر فى الوزن الأخضر والجاف مصحوبا بالنقص فى أطوال النباتات وأوراقها وعدد الأوراق للنبات الواحد مقارنة بتقاوى خالية تماما من أيه بذور حامول. كما انه يمكن استخدام تقنية جديدة لتقييم درجة تحمل أصناف البرسيم للاصابة بالحامول تحت ظروف العدوى الصناعية باستخدام معدلات عدوى مختلفة مقارنة بنمو هذه الاصناف تحت ظروف العدوى بأستخدام مقياس دليل التحمل (Tolerance Index) لتحديد درجة تحمل الاصناف المختبرة للاصابة للحامول. أوضح تاثير التفاعل بين أصناف البرسيم المختبرة تحملها للأصابة بالحامول عن صنف سرو تحت معدلات عدوى مختلفة ببذور الحامول ان أصناف جميزة 1 وجيزة 6 والهلالى وسخا 4 تتحمل إصابة أقل بالحامول تحت معدل عدوى 0.04 جم /اصيص مصحوبة بزيادة فى محصول البرسيم الغض والجاف وبعض الصفات المرتبطة بالمحصول مثل طول ووزن الساق وعدد الأوراق لنبات البرسيم ودليل درجة التحمل للأصابة بالحامول صنف جميزة1(70-73%) بمعدل **0.1-0.2**جم/اصيص عام 2016/2015 عن صنف السرو. أظهر للأصابة بالحامول صنف سخا 4 درجة تحمل للأصابة بالحامول (26.1-32.9%) والذى يعتبر صنفا حساسا للأصابة بالحامول طبقا لدليل الأصابة بالحامول.كما اوضحت هذة النتائج ان مربى البرسيم يمكن أن ينتخب اصناف من البرسيم العالية التحمل للأصابة بالحامول تحت ظروف العدوى الصناعية بمعدلات مختلفة من بذور الحامول مقارنة بظروف عدم وجود عدوى بالحامول والذى يعتبر تقنية سريعة وفعالة لتقييم عدد كبير من سلالات البرسيم للاصابة بالحامول قبل تقييمها تحت ظروف الحقل.

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